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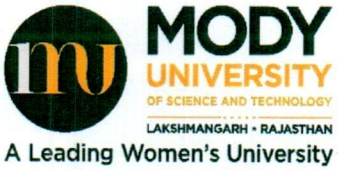

Research Proposal

Title	:	Cellular Automata Based IoT Enabled Smart Drip Irrigation System
PhD Candidate Name	:	Ms. Arpita Bhattacharya
Enrollment Number	:	2181200220 /170497
Department	:	Computer Science and Engineering
Supervisor Name	:	Dr. A. Senthil

1. INTRODUCTION

According to a report published by World Population prospects 2017 revision it is estimated that the world's population will reach 9.8 billion by 2050. India, is expected to become the most populated country by 2024. At present, on a global scenario, India is the 2nd in word farm output, 6th in agricultural export, and it produces one-tenth of the world fruit production [1].

The demand for food grain globally is projected to be 256 million tons by 2020. In order, to meet this demand, water is required for a crop production. According to the statistics, 70% of the fresh water, mainly from the underground reserves is needed for agricultural water consumption [1].

Globally, India has only 4% of world's fresh water and 16% of the global population. This creates an imbalance in the demand and supply of agricultural needs. So there is a need to adopt certain policy and scenarios backed by technology to save and conserve water and at the same time reduce water wastage in the agricultural sector. Although, India is a growing economy and utilizes technology to the best of possibilities, yet according to the statistics available, the total potential area to be covered under micro irrigation which includes drip irrigation and sprinkler irrigation is 42.2 million hectare of land whereas actually only 3.9 million hectare of land is covered which is only 9.2% of the planning done [2].

A large part of the water withdrawals are happening for agriculture as shown in figure 1. One of the core areas in Agricultural System is Water Distribution System. Hence, if Water Distribution Network System is managed and controlled in an optimised way, the burning issue of water scarcity for agricultural needs can be addressed [2] [17].

There are problems in the water distribution network like poor water allocation, inefficient use, leakage and its detection and mitigation, and lack of adequate and integrated water management. Some of the reasons for leakage in water distribution pipeline are highlighted below [22] [23] [24]:

- Pressure on the pipelines (when the pressure exceeds the maximum pressure rated by manufacturer which may cause deformation and results in exploding during water flowing)
- Pipe Corrosion

- Pipe Age
- Temperature
- Defect in Pipe
- Poor Quality of Joints
- Poor Quality of Workmanship

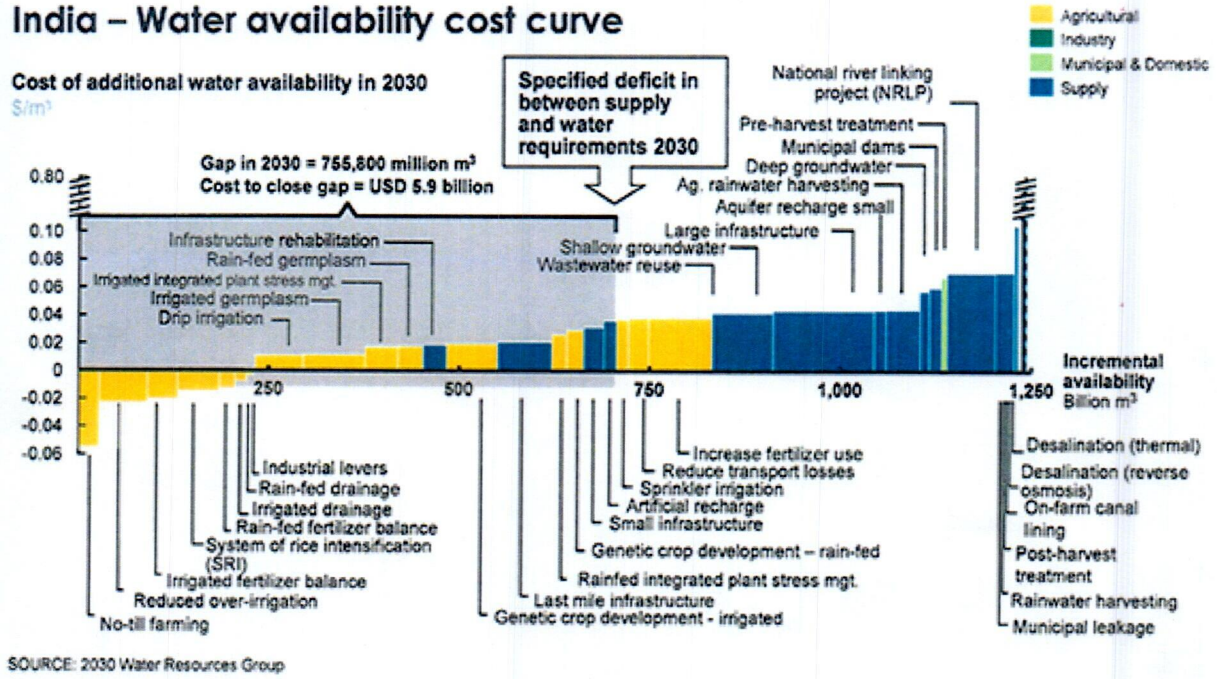

Figure 1. India Water Availability Cost Curve

Source: http://www.ide-india.org/content/water-india-facts

The above mentioned problems and reasons should be addressed in a proper way to reduce the wastage of water. Leakage and its detection and mitigation are a thrust area where research work has been carried out but it is still in its infancy stage. Another issue is the location of source of leakage and location accuracy which also needs to be addressed in a logical and scientific way. So one of the solutions is the use of Wireless Sensor Networks (WSNs) along with Mathematical Modelling using Intelligent Techniques which is one of the most suitable technique to detect and to localise anomalies in pipelines with respect to drip irrigation [11] [12] [14].

2. BACKGROUND

In 2014, Almazyad, A., Seddiq et. al., proposed a non-real-time RFID-WSN-based long-distance aboveground water pipeline leakage monitoring system which deployed a group of mobile sensor nodes inside the pipeline using mathematical model represented through three mechanisms viz., location-based, time-based, and interrupt driven. The authors used the technique in which only one sensor node remains active for a specific period of time while the other nodes were in sleep mode. The outcome of the proposed work was increased energy consumption of nodes, sharing of information about individual node's memory size and condition of the pipeline [4].

In 2015, Deepiga, M. T., & Sivasankari, A., proposed an underground wireless sensor network (UWSN) which had three sensors viz., water tank level sensor to detect the liquid level, water tank pollution sensor which records the signals of pH level, temperature, and turbidity to monitor the quality of water, and pipeline leak detection sensor through which ultrasonic signals are generated when a leak in the pipeline is detected and Force Sensitive Resistors (FSR) was used to measure the pressure to find the leak [5].

In 2017, M Daadoo & Y A Daragtmi, proposed a smart water leakage detection using wireless sensor network (SWLD) which employs two sensors viz., water sensor and water level sensor. If a leak is detected, the message is communicated to the owner through mobile communication and the owner has the option of switching off or on the water motor. If a risk is detected, the system issues command to close the solenoid valve to stop the water supply to the track where the leakage occurred [6].

In 2017, M. Daadoo, A. Eleyan, D. Eleyan. 2017, proposed an optimization water leakage detection (OWLD) system which consists of two parts, the first part is the alarm based on Global System for Mobile Technology (GSM) to send SMS to owner and the second part is the controlling part which uses android mobile application to control the pump. As claimed by the researchers, the proposed system can effectively improve the efficiency of operation, reduce delay time and cost of maintenance of the pipeline after detection of leakage [7].

In 2018, Reddy, P. S., et. al., proposed a water leakage detection monitoring and controlling system using IoT which is an automated system in which, when the motor switch is turned on the water flow through the pipeline from the inflow of the pipeline and goes out through the outflow

of the pipeline. An LCD connected to the system shows the inflow and outflow rate of the water. The leakage in the water pipeline is detected by monitoring the variation in inflow and outflow rate of water in the pipeline. If the variation is found the leakage is detected and is shown on the LCD and a message is send via GSM to the owner and accordingly the motor is shut off to cut the water supply [8].

Almeida, F. C., et. al., investigated the way in which resonances in a buried pipe system affect time delay estimation due to a leak calculated using the BCC and PHAT correlation functions. To show the implication, a model of a pipe system, which includes the noise propagation through the pipe, the sensors and resonators, has been developed [9]. Najwa Rosli et. al., proposed a home underground pipeline leakage alert system based on water pressure which consist of a conceptual framework having two main stage, in the first stage, water pressure is monitored inside the pipeline and the second stage, send an alert notification if the water pressure drop below 2.7 KPa [10].

Darsana, P., & Varija, K., presented a review of the leakage detection studies for the water supply systems in which the authors discussed about the difficulties in procuring the various sensors and devices due to the cost factor and also concluded that despite of all the odds, there are lots of studies to be undertaken for the betterment of the leakage detection methods [11]. Chan, T. K., Chin, C. S., & Zhong, X. presented a review of current technologies and proposed intelligent methodologies like support vector machine, neural network and convolution neural network, etc. for water distributed network leakage detection. Several uncertainties associated with the implementation of WDN leakage detection along with several suggestions are also discussed [12].

Qi, Z., Zheng, et. al., a methodology to investigate the underlying capacity of existing PSSs for pipe burst detection using a set of quantitative metrics. The proposed metrics focused on the identification of nodes where the bursts cannot be detected using PSS, undetectable demands which are derived from the demands of undetectable nodes, and detection dimension which represents the number of sensors that can simultaneously detect a burst in a node. Also the spatial region where bursts within each sub-region can be detected by a particular sensor with a minimum outflow along with the detectable threshold, which shows the minimum burst outflow

of each node triggering its associated pressure sensors. The proposed system facilitates decision-making processes regarding sensor placement and burst localization [13].

Abd Rahman, N., et. al., provides a review of research trends highlighting water leakage control strategies that focus on pressure management, active leakage control, pipe rehabilitation, asset management and District Metered Area (DMA) design.. The authors concluded that the main strategy to reduce water leakage is the pressure management of water distribution systems using optimal settings of a pressure reducing valve installation [14].

Yazdekhasti, S., et. al., proposes a non-intrusive pipeline surface vibration-based leak detection technique for addressing the issues surrounding labour-intensive acoustic techniques for leakage detection involves continuous monitoring of the change in the cross-spectral density of surface vibration measured at discrete locations along the pipeline. Through experimental study, the authors showcase the potential feasibility of the proposed technique to detect and assess the onset of single or multiple leaks in a complex system [15].

Reshma, H., & Radha, R., proposed a node based system with the feature of detection of leakage and identification of any threat in real-time using solar powered wireless sensor network for pipeline monitoring system [16]. Azevedo, B. B., & Saurin, T. A., presented a review on losses in water distribution system which highlights the factors that influence the complexity of WDSs, having an impact on the losses of water and the complexities of the various methods used to control losses in WDS. Non-linear interactions were the attribute most frequently accounted by the methods (36.5%) [17]. Giaquinto, N., et. al., proposed a sensor for leak detection in underground water pipes which addresses the limitation in a domain reflectometry (TDS) based leak detection method [18].

Sadeghioon. A. M., et. al., proposed a water pipeline failure detection using distributed relative pressure and temperature measurements and anomaly detection algorithms. The validation of the new system in a field trial over a 6-month period showed that all the known leaks were identified with 98.45% accuracy [19].

In 2019, Shanmukh, S., Sai,, et. al., IoT-based pipe burst detection in water distribution systems which monitors the water flow and performs the controlling of the water supply and communication is done using IOT [20]. Baroudi, U., Devendiran, A., & Al-Roubaiey, A., presents a survey of pipeline leak detection system and data fusion approaches that are applicable to pipeline monitoring [21]. El-Zahab, S., & Zayed, T., presents a survey of the leak distribution

in water distribution networks. The authors highlighted two classes of leak detection systems which are identified, static leak detection systems and dynamic leak detection systems. The two systems are defined as well as their differentiative capabilities are also shown [22].

Fuad, Z. A., Eddy, et. al., provides review of the leak detection method and technology. The authors suggested and highlighted many methods to detect a leakage such as sound, acoustic, vibration, sensor, pressure, etc. They advocated that Real time-based sensors will notify any incidence and the algorithm will forecast leakages [23].

Limitations

After review of the related work, following limitations were identified, which can be potential research area to be carried out in future:

- Most of the models proposed are signal based rather model based which imposes the limitation of Not suitable for dense spatial deployment for continuous monitoring of pipes due to their high cost, high sampling rate (causing high power consumption), and need for intensive processing power.
- One of the research work propose the detection of leakage using the inflow and outflow rate of the water in pipeline which does not seems very promising and comprehensive as far as the leakage detection and location accuracy is concerned.
- In most of the research work carried out, the experimental setups are of basic nature and either does not consider interlinking of pipelines or presented a very simpler view. A more complex and non linear setup of pipeline may be used for comprehensive evaluation and accuracy.
- Most of the literature survey does not consider parameters and constraints like friction, pipeline diameter, frictional coefficient, etc. associated with water and pipeline design which is needed for a more accurate reading.
- No any concrete method can be seen for locating the source of leakage.
- The accuracy of leakage location is another area which is mostly not considered.

3. RESEARCH GAP

To the best of our knowledge, the problem of monitoring water pipelines and especially Detection and Location Accuracy of Leakage using WSNs in a smart drip irrigation has not been properly addressed in the published literature, despite its requirement in the practical field. The reason being non linear and complex approach of water pipeline which may be appropriately addressed by Cellular Automata.

Using Cellular Automata theory we intend to design a model which considers the interlinking of pipelines which represents a complex and non linear setup for comprehensive evaluation and accuracy of leakage source.

The use of Cellular Automata in the proposed algorithm will take into consideration the parameters and constraints like friction, pipeline diameter, frictional coefficient, etc. associated with water and pipeline design which is needed for a more accurate readings of source and location of leakage in the pipeline.

4. OBJECTIVES

Following are the objectives to be achieved with respect to Cellular Automata Based smart drip irrigation system

1. To study various leakage detection techniques i.e., signal based and model based.
2. To analyze the feasibility of model based leakage detection technique and find the best one.
3. To design an Cellular Automata Based algorithm using a model leakage detection technique to improve the location accuracy of leakage in the pipeline grid.
4. Comparing the performance of the Cellular Automata Based Algorithm with other existing techniques for location accuracy and simulate the results.

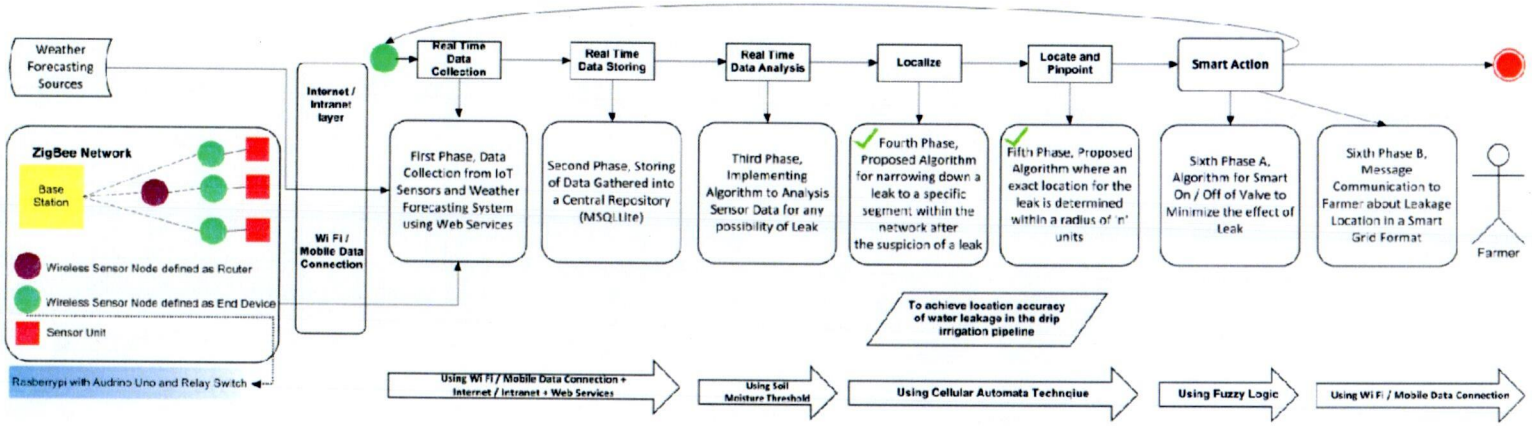
Weather Forecasting Sources
ZigBee Network
Base Station
Wireless Sensor Node defined as Router
Wireless Sensor Node defined as End Device
Sensor Unit
Rasberrypi with Audrino Uno and Relay Switch
Internet / Intranet layer
Wi Fi / Mobile Data Connection
Real Time Data Collection
Real Time Data Storing
Real Time Data Analysis
Localize
Locate and Pinpoint
Smart Action
First Phase, Data Collection from IoT Sensors and Weather Forecasting System using Web Services
Second Phase, Storing of Data Gathered into a Central Repository (MSQLLite)
Third Phase, Implementing Algorithm to Analysis Sensor Data for any possibility of Leak
Fourth Phase, Proposed Algorithm for narrowing down a leak to a specific segment within the network after the suspicion of a leak
Fifth Phase, Proposed Algorithm where an exact location for the leak is determined within a radius of 'n' units
Sixth Phase A, Algorithm for Smart On / Off of Valve to Minimize the effect of Leak
Sixth Phase B, Message Communication to Farmer about Leakage Location in a Smart Grid Format
Farmer
To achieve location accuracy of water leakage in the drip irrigation pipeline
Using Wi Fi / Mobile Data Connection + Internet / Intranet + Web Services
Using Soil Moisture Threshold
Using Cellular Automata Technqiue
Using Fuzzy Logic
Using Wi Fi / Mobile Data Connection

Figure 2. Proposed Architecture of Cellular Automata Based IoT Enabled Smart Drip Irrigation System

Characterization of Water Pipeline using Cellular Automata

- Temperature, flow rate and pressure as input
- Water Pipe line (cellular space)
- Cellular state of water

  (four state –empty, filling full and idle)
- Cellular properties of water- temperature, pressure , partial friction coefficient, different spatial location,

CA Model for finding leakage

- Temperature models
- Pressure model
- Cellular evolution rule

6. METHODOLOGY

In this section, we are exhibiting the steps for achieving our goal. We have divided our entire work in different phases. By following these steps we will able to develop our proposed cellular automata based algorithm for leakage detection and location accuracy.

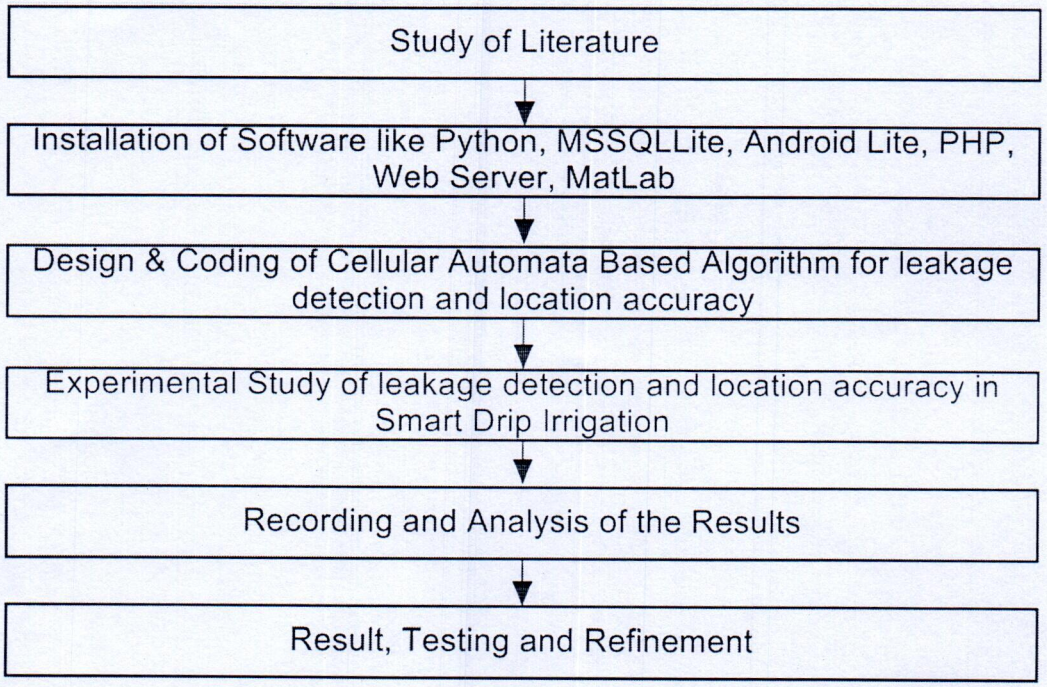
Study of Literature
Installation of Software like Python, MSSQLLite, Android Lite, PHP, Web Server, MatLab
Design & Coding of Cellular Automata Based Algorithm for leakage detection and location accuracy
Experimental Study of leakage detection and location accuracy in Smart Drip Irrigation
Recording and Analysis of the Results
Result, Testing and Refinement

Figure 3. Flowchart of the Research Plan

The research plan is divided into following phases:

Phase 1- Study of literature: We will collect more relevant, updated literature regarding the concerned topic. We will analyze the previous work that has been done by the research scholars. By the study we will be capable for identifying drawbacks, gaps in the previous work.

Phase 2-Installing the software: After the study of the literature, we will install the required software. For this research work we are using Python, MSQLite, Android Lite, Web Server, MatLab.

Phase 3- Design and Coding of Proposed Algorithm: On this phase, we intend to design cellular based algorithm for leakage detection and location accuracy in a Smart Drip Irrigation System Setup. Coding will also be done in this phase for its practical implementation.

Phase 4- Experimental Study: In this phase, we intend to set up an experimental study for leakage detection and location accuracy and implement the proposed cellular automata based algorithm.

Phase 5- Recording and Analysis of the Result: In this phase we will collect the results from the experimental study carried out in phase 4 of the research methodology. Finally we will carry the analysis of the result using Matlab Simulation and statistical methods. We will depict the results in the form of graph.

Phase 6- Result Testing and Refinement: After the analysis, if obtained results depict the better enhancement, we will further proceed for documentation otherwise we will calibrate our proposed cellular automata algorithm with the parameters and constraints till better and proposed results are received.

7. DATASETS

- IHITC (International Horticulture Innovation And Training Center), Durgapura, Jaipur, Rajasthan, India
- Horticulture Department, Pant Krishi Bhawan, C-Scheme, Jaipur, Rajasthan, India

www.agriculture.rajasthan.gov.in

- Rajasthan Agricultural Research Institute (RARI), Durgapura, Jaipur, Rajasthan, India

raridurgapura.org

8. TIME TABLE

Task	First Year				Second Year				Third Year				Deliverables
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Phase 1													Study the literature
Phase 2													Installation of Software
Phase 3													Design & Coding of Cellular Automata Based Algorithm for leakage detection and location accuracy
Phase 4													Experimental Study of leakage detection and location accuracy in Smart Drip Irrigation
Phase 5													Recording and Analysis of the Results
Phase 6													Testing and Refinement

9. S/W. AND H/W. REQUIREMENTS

Hardware Requirements

- Sensors
  - Soil Moisture Sensor
  - Temperature Sensor
  - Humidity Sensor
  - Wind Velocity Sensor
  - Rainfall Sensor
- Relay (to control the water pump)
- Arduino Uno R3
- Rasberrypi
- Zigbee

Software Requirements

- Python
- Android Studio (Android Application)
- MSQLLite / MSSQL (Database)
- MatLab (Simulation)

REFERENCES

[1]. Reghunadhan, R. (2020). Big Data, Climate Smart Agriculture and India–Africa Relations: A Social Science Perspective. In IoT and Analytics for Agriculture (pp. 113-137). Springer, Singapore.

[2]. Water - India Facts, retrieved from http://www.ide-india.org/content/water-india-facts on 12th Dec., 2019 at 5:45 PM.

[3]. Ganguly, N., Sikdar, B. K., Deutsch, A., Canright, G., & Chaudhuri, P. P. (2003). A survey on cellular automata.

[4]. Almazyad, A., Seddiq, Y., Alotaibi, A., Al-Nasheri, A., BenSaleh, M., Obeid, A., & Qasim, S. (2014). A proposed scalable design and simulation of wireless sensor network-based long-distance water pipeline leakage monitoring system. Sensors, 14(2), 3557-3577.

[5]. Deepiga, M. T., & Sivasankari, A. (2015). Smart water monitoring system using wireless sensor network at Home/Office. International Research Journal of Engineering and Technology (IRJET), 2(04), 1305-1314.

[6]. Daadoo, M., Eleyan, A., & Eleyan, D. (2017, July). Optimization Water Leakage Detection using Wireless Sensor Networks (OWLD). In Proceedings of the International Conference on Future Networks and Distributed Systems (p. 5). ACM.

[7]. M Daadoo, Y A Daragtmi. (2017). Smart Water Leakage Detection Using Wireless Sensor Networks (SWLD). International Journal of Networks and Communications, 7(1), 1-16.

[8]. Reddy, P. S., Chanakya, K. V., Eswari, B., & Bhupati, C. (2018). Water leakage detection monitoring and controlling system using IOT. International Journal of Engineering & Technology, 7(2.7), 120-123.

[9]. Almeida, F. C., Brennan, M. J., Joseph, P. F., Gao, Y., & Paschoalini, A. T. (2018). The effects of resonances on time delay estimation for water leak detection in plastic pipes. Journal of Sound and Vibration, 420, 315-329.

[10]. Rosli, N., Aziz, I. A., & Jaafar, N. S. M. (2018, November). Home Underground Pipeline Leakage Alert System Based on Water Pressure. In 2018 IEEE Conference on Wireless Sensors (ICWiSe) (pp. 12-16). IEEE.

[11]. Darsana, P., & Varija, K. (2018). Leakage detection studies for water supply systems—A review. In Water Resources Management (pp. 141-150). Springer, Singapore.

[12]. Chan, T. K., Chin, C. S., & Zhong, X. (2018). Review of Current Technologies and Proposed Intelligent Methodologies for Water Distributed Network Leakage Detection. IEEE Access, 6, 78846-78867.

[13]. Qi, Z., Zheng, F., Guo, D., Maier, H. R., Zhang, T., Yu, T., & Shao, Y. (2018). Better understanding of the capacity of pressure sensor systems to detect pipe burst within water distribution networks. Journal of Water Resources Planning and Management, 144(7), 04018035.

[14]. Abd Rahman, N., Muhammad, N. S., & Wan Mohtar, W. H. M. (2018). Evolution of research on water leakage control strategies: where are we now?. Urban Water Journal, 15(8), 812-826.

[15]. Yazdekhasti, S., Piratla, K. R., Atamturktur, S., & Khan, A. (2018). Experimental evaluation of a vibration-based leak detection technique for water pipelines. Structure and Infrastructure Engineering, 14(1), 46-55.

[16]. Reshma, H., & Radha, R. (2018). Solar Powered Wireless Sensor Network For Pipeline Monitoring System. International Journal of Innovative Research and Advanced Studies (IJIRAS), 5(7), 274-282.

[17]. Azevedo, B. B., & Saurin, T. A. (2018). Losses in water distribution systems: A complexity theory perspective. Water resources management, 32(9), 2919-2936.

[18]. Giaquinto, N., D'Aucelli, G. M., D'Ingillo, R., Prudenzano, F., & Attivissimo, F. (2018, October). Development of a Sensor for Leak Detection in Underground Water Pipelines. In 2018 IEEE International Workshop on Metrology for the Sea; Learning to Measure Sea Health Parameters (MetroSea) (pp. 268-272). IEEE.

[19]. Sadeghioon, A. M., Metje, N., Chapman, D., & Anthony, C. (2018). Water pipeline failure detection using distributed relative pressure and temperature measurements and anomaly detection algorithms. *Urban Water Journal*, *15*(4), 287-295.

[20]. Shanmukh, S., Sai, M. P., Charan, S. S. S., & Chidambaram, N. (2019). IoT-Based Pipe Burst Detection in Water Distribution Systems. In Innovations in Computer Science and Engineering (pp. 599-604). Springer, Singapore.

[21]. Baroudi, U., Devendiran, A., & Al-Roubaiey, A. (2019). Pipeline Leak Detection Systems and Data Fusion: A Survey. arXiv preprint arXiv:1902.03927.

[22]. El-Zahab, S., & Zayed, T. (2019). Leak detection in water distribution networks: an introductory overview. *Smart Water*, *4*(1), 5.

[23]. Fuad, Z. A., Eddy, H. S., Badronnisa, Y., & Syazwani, I. (2019, November). Water leak detection method in water distribution network. In *IOP Conference Series: Earth and Environmental Science* (Vol. 357, No. 1, p. 012033). IOP Publishing.

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COMPARATIVE STUDY OF IOT TOOLS USED FOR CROP MONITORING IN SMART AGRICULTURE

Arpita Banerjee and A. Senthil
Mody University, Lakshmangarh, Sikar, India
E-mail : arpitaa.banerji@gmail.com

ABSTRACT

Agriculture plays a very important role in the development of Indian economy. Farmers if aware about their surroundings can contribute widely in the agricultural development. Many improvements and enhancement have been inculcated from past to help the farmers so that optimum utilisation of resources, maintaining the fertility of soil, temperature, humidity , efficient usage of power and irrigation methods, etc can be achieved. This may not only beneficial to the famers but also to the larger section of the rural poor who are directly , indirectly involved in agricultural activities as consumers. This will provide a excellent crop productive environment which facilitates the over all rural development. Beside them, this sector is also facing the crises of lack of man power and lack of water, which adversely affects the production of crops. Use of IoT devices is one of the solution one could find in this type of environment. This paper highlights the comparative study of all the available IoT tools to monitor production of crops. As IoT has already entered the agricultural domain, itshowcased efficient ways to increase and maintain thecropproduction, balanced prices of agricultural tools, herbicides, fertilizers etc. The use of IoT devices for agriculture especially for developing and monitoring crop production hasled to the collaborated environment necessary for the development of the economy as a whole.

Key words : *Sensors, Internet of things, modern agriculture, smart farming, digital farming, crop monitoring.*

As the population of the world is increasing with a rapid speed so the need to provender them is also growing. The years old techniques of doing farming is not sufficient to produce those extra grains. Besides old techniques, some natural and man made factors are also responsible for poor production. Natural factors cannot be removed but can be minimised if proper and timely measure are adopted, whereas man made barriers can be totally removed by using modern and scientific means of farming .Internet of Thing is one such domain which is getting pace and recognition worldwide in agriculture. IoT based devices are able to control the environment to a greater extent. Not only this they are trying to solve two biggest problems of farmers like lack of irrigation facilities and lack of man power which adversely affect the crop productions It is proved by many researchers that the use of machine has always reduced the labour of men. They help the farmers to keep a watch on the growth of the crops, timely spaying of fertilizers and pesticides, protection from wild animals and many uncountable numerous jobs.

With the modernization, the farming has become more structured and can be even planned in advanced, making the farmers as smart farmers. The farmers can not only test their soil fertility themselves but can grow crop according to the temperature , humidity , moisture of the soil thus making ideal utilization of land. Farmers are no longer considered to be uneducated whom any one can misuse for their personal gains. Today's farmers are well educated and can understand the benefit of using machine and technology in their farming. The use of digitization by the government are creating awareness and interest among the youth to adopt agriculture as their profession. Due to the flexible loan policies made by the government and creating retailers where expensive IoT devices could be available on low prices, efforts are made at both ends to improve the present agricultural scenario.

Timely researchers have proposed many algorithm and software framework which if implemented can yield better results in form of increased crops production. Production itself is not sufficient, it is associated with many other works like monitoring its growth, safeguarding it from wild animals, spraying of pesticides, fertilizers on them timely, removing the unwanted plants around them so that their growth may not get affected etc are all important. Many device been introduced as and when needed to fulfil the above mentioned tasks.

This research paper presents a comparative study of commonly available tools in the field of agriculture to increase crop productions. The paper also focuses the use of Internet of Things technology along with the need of cloud computing and Network technologies. The rest of the paper is organized as follows: In Section II, contribution made by researchers in the field of Internet of Things applied in Crop Monitoring is briefly reported, whereas in Section III, we present the Limitation of the mentioned works. Section IV presents Conclusion and Future Research Directions.

Contribution by the Researchers

The traditional means of agriculture are not sufficient in giving optimum results. Some of the farmers who have not accepted this digital change is agriculture have to still struggle due to geographical discrepancies, inadequate irrigation facilities, temperature, variation is soil, costly fertilizersetc. This create excessive depression among them, and when they don't get any type of help from anywhere they take drastic steps like committing suicide.

The use of IoT devices can be used to resolve these problems to greater extent .This technology is well equipped with sensors and other modern equipment which are connected with the server. The servers are used to keep large voluminous data which are made available to the farmers on regular basis through a well-defined network. Contribution of many researchers are appreciable in converting traditional agriculture to smart agriculture by using of IoT devices. These devices have reduced human intervention and human dependency to a greater extent. [3] Internet of Things technology generally creates an informative environment, thus trying to make agriculture digitize. [1]. In this digital world every one will be connected with each other and always ready to help each other.

It seems like farmers of twenty first century will be well aware of using all types of agricultural devices [1] A group of researchers headed by ManlioBacco have discussed various types agricultural equipment's in their research work. These equipment if used wisely may increase the crops yields. One such machine is Ariel Drones that are considered to be the most efficient agricultural equipment in land and crop monitoring.

Drones are very helpful is identifying uneven distribution of water, fertilizers, pesticides etc making the farmers aware all the time. They have also discussed the various available wireless technologies in their research work. Proper communication and information if given about these technologies to the farmers, they may make their living better and may contribute to economic development [1].

Researchers like Vijay andVishal[2] have proposed an intelligent monitoring platform framework to monitor the agriculture system based on IOT. The device was directly link to the smart phone. The use of smart phone have become very common as they are easily available at cheap prices and most likely easy to operate.The sensors used in the fields get directly connected with these phone, making the farmers aware and updated of every single action taken place in their farms. In this way farmers are always aware and updated with necessary information [1].

This framework requires less interaction and interference of human being thus creatingahuman less environment which is based on efficient use of technology to enhance the production conditions [3]. Self-operated machines may become advantageous in a condition where the young versatile generation are not showing interest to adopt farming as their profession. This a major threat to agriculture but can be minimised by using no man automated machines [3].

Production is all about growth of crops. But if the growth is not proper then it may not yields better results. The growth of the crop is directly related with the fertility of soil, time and evenly distribution of fertilizers, monitoring the plant, spraying of pesticides when needed, maintaining the moisture of land, adequate irrigation facilities etc [3]. Researcher like Anuja Chandgude have explained a crop monitoring system in their research paper.This tool may help the farmers to take decision relating to growth of crops [3].

In their proposed system Artificial Neural Network based algorithm is used to collect data. The sensed data is then compared with previous data. The farmer take the decision based on these comparisons. This system helps the farmers with prediction of any disease in the crops. It also supply remedial information and prevention measure, if undertaken may give good results [3].

Researcher like *H. Varma* have great contribution in making device that are predicting change in temperature and humidity of the surroundings. Change in climate creates confusion in the farmers about the type of crop production [4]. This device will help the farmer to provide irrigation facilities when need only, thus avoiding the unpredictability and uncertainty of producing crops. Also the time of irrigation can be determine. It will also calculate the amount of fertilizers need for that particular production and will automate the motor pump use for supplying water and fertilizer to the fields.

These IoT based devices issue awareness message based emails which are accessible by the farmers. This research work is highly appreciable as it informs the farmer that different crops require different level of water, fertilizer etc. for their growth. It also helps the farmers in doing rotation of crops [4].

Researchers like Carlos and Sandra has presented a multimedia framework which when applied to agriculture can give productive results. This frameworks use all the latest techniques along with IoT devices to assimilate smart irrigation system. They have made the entire framework on 868 MHz wireless mesh network. The aim of these researchers is to provide a hassle free

autonomous human intervention free decision making mechanism which is based on modern communication technologies and intelligent context service system [5].

This type of environment give control regarding production and monitoring of crop, thus in terms becomes a great benefit for irrigation and for saving energy andwater [5].

As it is rightly said that old is gold. It goes very well with some of the farmers who are quite rigid enough to follow the same old farming techniques and yet hoping for better results. The researchers like (6) have proposed mechanism" AGROTECH" named, to enhance traditional farming techniques. They have used modern wireless sensor network technology to promote rural agriculture [6].

The IoT based application keeps a track of various field activities like production, monitoring of crop, spraying of fertilizers, irrigation channels etc. this device provides real time updates through emails to the concerned person [6]. On the basis of moisture of soil the sensor activate the irrigation sprinklers or motor pump to moderate the effect of water scarceness by the observing the level of water sensor in the tank and also the temperature sensor [6]. This device sendssms in case of emergency and a generalised summary in form of report on user demand.

Various factors like soil fertility, moisture and humidity, adequate amount of fertilizer etc. yield good quality. [7] Researchers like Shruti and Rekha in their research work have engrossed the importance of quality of soil required for better production of crops. The traditional use of farming not incompetent leading to either excess or scarcity of everything right beginning from soil health to wastage of water, fertilizers, pesticides etc. They have proposed the use of cloud architecture to act as a server where real time data's are stored, making it available as and when required for decision making. [8]

They have used various types of sensors to capture real field data which are being analysed on MATLAB for optimum result [8]. They have used IoT based services to produce a network which will monitor the fields. Thelimitation of the traditional GPRS based system problems were reduced to a greater extent [8].

Researchers like MohanrajandKirthika has proposed an E Agriculture Application which will provide all the time information to the farmers. [9] Farming is not a one-time effort, it is an entire cycle which has to get started right from preparing the land for cultivation till the crops are ready for market. Therefore it is very essential for the farmers to be updated all the time with recent information.

Although IoT may prove advantageous in the field of agriculture, it is only possible with uninterrupted Internet speed. Getting access to Internet smoothly all the time is an important challenges generally faced by the user . Researchers like Kiran and Dr.Chhaya have explained the scope of IoT devices and their dependency on Internet for its survival [10]. According to them cloud architecture if used with IoT may prove beneficial in the field of agriculture.

LIMITATIONS

All the works describe above have some extent of limitation in their research areas which are listed as follows :

- The researchers are not able to explain how deep learning techniques are useful in increasing production. A comparative implementation of Unnamed Ground Vehicles and Unnamed Ariel Vehicles in agriculture is missing. Due to lack of combine usage production will vary [1].
- Various techniques and methods can only be used by the farmers if they are well educated and well aware about the usage. Incompleteknowledgeis generally harmful and may give reverse results [3]. Proper measure should be suggested to make them awared.
- The research could be done on large number of parameters like abnormal weather conditions, bacterial or fungal growth on plants, range of pesticides to be used etc. In a country where more that 60% population depends on agriculture a wide range of feature are needed. Limited work may not give substantial results if applied beyond the set parameters [4].
- A standard irrigation communication protocol needs to be developed which may be accepted widely [5]. System should be made secure to prevent data loss. Security is a major issue and should be well focused in advance before implementing the technologies.
- Agriculture is one such domain where theoretical implemented is not successful unless it is practically implemented on fields. Farmers in India are suffered from natural calamities like inadequate rainfall. Majority of farmers are still depended on rainfall for their crop cultivation [6]. Some cheap efficient water management technology based system is needed in a developing country like India. the system should be intelligent to check all mention parameters and suggest the farmer the type of crop production.
- Researchers can work in the areas of developing solar base IoT devices. These devices should use solar radiation through efficient wireless technology

to develop crop production and monitoring techniques [7].

- Some cheap, easy to implement technology may be helpful to the farmer to a great extent to grow more food grins on the same piece of land. The researchers should spend more time in developing this type of technological devices [7].
- Data mining techniques and predictive analysis is also an area where lot of work can be done to analyse the data generated from applied technology.[8] Self learning documentation can be added to help the farmers in decision making.
- Besides mentioned many other aspects of agriculture are left unidentified which may contribute to effective production of crops. As the population is increasing and land covering agriculture is decreasing more efficient techniques needs to be implemented [9].
- Youths needed to be motivated to make career in agriculture. Researchers should work in the field to generating employment means using agriculture [1].
- Government and industries expert should come forward to solve the problem of uninterrupted Internet. The successful execution of every method, every framework, every protocol and every architecture is depended on the speed of internet [1].
- Developing cheap devices may not be successful in qualifying security constrains. If servers are being used to maintain large amount of distributed data then security parameters should be planned well in advanced [4].

CONCLUSION

India's population is growing with a rapid speed and so is the volume of land is decreasing. More innovative methods should be made available to the farmers at minimized rates. Present scenarios is such that farmers are not well educated. This make the role of brokers very strong. Most of the farmers are depended on these brokers or middleman to get their work done. Government along with NGOs should play a vibrant role in making the farmers aware about their rights and duties.The farmers should also be given information about various agricultural activities like, identifying soil fertility and weather condition, techniques of sowing and reaping seeds according to soil types , fertilizer according to seed etc[4]. Besides this farmers should be given basic knowledge to access software technologies on smart phones.

More and more of farmers should be encouraged to attend more and more of government regulate camps on digitization of agriculture [4]. The farmers also faced theproblems of lack of availability of equipment. Heap devices but secure should be made available and proper rules should be implemented to minimize the use of middleman and anyone who tries to exploit the farmers. More and more of youths should be motivated to adopt agriculture as their profession so that we can build a productive environment for our upcoming generations.

Future Directions

The future scopes are to develop cheap secure devices. Researchers can contribute in developing some type of sensor based devices which are available at affordable rates. More research work can be done in this stream . Besides this security of data and networking devices is an interested area to work on. More rules should be framed by the Government to provide right markets to the farmers, removing the middleman who is generally benefitted by both the parties. More strict policies should be framed so that no farmers are being misguided.

REFERENCES

1. Manlio Bacco (2018). Andrea Berton Smart Farming: Opportunities, Challenges and Technology Enablers, 2018 IoT Vertical and Topical Summit on Agriculture - Tuscany (IOT Tuscany)
2. V. Vijayhariram, H. Vishal (2015). Regulation of Water in Agriculture Field Using Internet Of Things, *IEEE International Conference on Technological Innovations in ICT for Agriculture and Rural Development.*
3. Nikesh Gondchawar, R.S. Kawitkar (2018). *International Research Journal of Engineering and Technology (IRJET) Volume: 05 Issue: 04.*
4. H. Varma C. Mulla (2017). Fertigation and Irrigation System for Agricultural Application along with Soil Monitoring using IoT VJER-Vishwakarma *Journal of Engineering Research* www.vjer.in Volume 1 Issue 2, June.
5. Carlos Cambra, Sandra Sendra An IoT Service-Oriented System for Agriculture Monitoring Conference Paper · May 2017 DOI: 10.1109/ICC.2017.7996640
6. Mr.O.Pandithurai, S. Aishwarya (2017). Agro-Tech: A Digital Model For Monitoring Soil And Crops Using Internet Of Things (Iot). *Third International Conference on Science Technology Engineering & Management.*
7. Shruti A Jaishetty, Rekha Patil, Iot Sensor Network Based Approach For Agricultural Field Monitoring And Control, IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308
8. Mohanraj I (2016). a, KirthikaField Monitoring and Automation using IOT in Agriculture Domain, *6th International Conference On Advances In Computing & Communications, ICACC 2016,* 6-8 September 2016, Cochin, India.

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